THE LANCET Global Health

Supplementary appendix

This appendix formed part of the original submission and has been peer reviewed. We post it as supplied by the authors.

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This supplementary appendix has been corrected. The corrected version first appeared at www.thelancet.com/lancetgh on Feb 21, 2014.

Appendix

1 Supplementary methods

1.1 Mathematical models

This section gives a brief summary of the features of the twelve epidemiological models included in this analysis. Other than changes in ART eligibility and uptake, model projections do not include other prevention efforts or changes in risk behaviour in future projections. Model projections of population size, HIV prevalence, HIV incidence, and numbers on ART for the baseline epidemic calibration are presented in section 2.1.

1.1.1 Generalised epidemic settings

In the generalised epidemic settings, all models represented the entire adult population, aged 15 years and older. For South Africa and Zambia, all models were calibrated to match the same estimates for the size of the adult (aged 15+ years) population, HIV prevalence among 15–49 year olds, and the number adults (aged 15+ years) on ART in mid-2011 in Table S1:

Table S1: Generalised epidemic calibration estimates[1]

	South Africa	Zambia
Age 15+ population size, mid-2011:	35,015,633	7,010,595
Age 15–49 HIV prevalence, mid-2011:	17.3%	12.5%
Age 15+ number on ART, mid-2011:	1,416,100	352,258

Seven models (Goals, STDSIM, EMOD, BBH, PopART, Synthesis, Menzies) simulate the national HIV epidemic in South Africa, and four simulate the national HIV epidemic in Zambia (Goals, EMOD, Macha, PopART), with three (Goals, EMOD, PopART) separately calibrated to both settings. Goals, BBH, PopART, Menzies, and Macha are deterministic compartmental models. STDSIM, EMOD, and Synthesis are individual-based microsimulation models. All models simulate HIV transmission between two sexes except Menzies, which does not explicitly distinguish sexes. Goals, STDSIM, EMOD, and Synthesis include age structure and age-specific natural mortality rates, and Goals, EMOD, and Synthesis incorporate more rapid HIV progression for older adults. BBH and Menzies assume that sexual mixing and the risk of HIV infection are homogenous in the general population, while the remaining models incorporate heterogeneity in sexual risk among the general population in different ways.

In addition to heterogeneity in sexual mixing in the general population, four of the generalised epidemic models (Goals, STDSIM, EMOD, BBH) include some key populations. Goals, STDSIM, and BBH explicitly model HIV transmission among FSW. Goals and BBH simulate HIV transmission among men who have sex with men (MSM), and BBH allows transmission between MSM and heterosexual partners of MSM.

Goals, STDSIM, EMOD, BBH, and PopART model HIV progression and transmission as discrete stages. For Goals, BBH and PopART these stages relate to CD4 >500, CD4 350–500, CD4 200–350, and CD4 ≤200 cells/μL, while CD4 count declines continuously after seroconversion and infectiousness is represented as discrete stages related to stage of infection. Synthesis jointly and continuously models CD4 cell count decline, viral load, and the risk of morbidities, allowing these models to consider eligibility for those with CD4 ≤500 cells/μL. HIV infectiousness increases as the CD4 cell count/category declines and each also incorporates a short period of high infectiousness immediately after becoming infected. Menzies models HIV progression in stages of CD4 >350, CD4

200–350, and CD4 ≤200 cells/μL. Goals, PopART, and Menzies model the effect of HIV infection and ART on progression to active tuberculosis (TB) disease and TB transmission.

1.1.2 Concentrated epidemic settings

Three models–Pruddell, Mishra, and IDU-Manipur–represent different regions and epidemic types in India. Mishra represents the entire adult (age >15 years) population of Belgaum, India, where the HIV epidemic is primarily driven sex work, and in which a successful targeted intervention programme among FSW initially implemented through the Avahan intervention programme has increased condom usage and access to ART among FSW, and thereby substantially reduced HIV incidence over the past decade.[2,3] Mishra stratifies the population into high and low volume FSW, former FSW, male clients of FSW, former male clients, and the remainder of the general population. Mishra contributes two model simulations: one which projects HIV incidence including the successful effects of the condom-based prevention programme over the past decade, and a second in which the epidemic is simulated assuming the increase in condom usage and ART access had not occurred, resulting in higher HIV incidence, which we refer to as the 'Mishra – no FSW intervention' model.

Pruddell represents a subset of the adult population in Bangalore, India, where the epidemic is primarily drive by FSW and MSM. The populations represented include current and former FSW, male clients of FSW, and MSM, but does not include the general population, who may be sexual partners of these populations. It simulates immediate ART and expanded access for current FSW and MSM, and both of these groups simultaneously.

IDU-Manipur represents a subset of the adult population in Churachandpur district in Manipur state, where the epidemic is primarily driven by unsafe drug injecting. The persons represented include high-activity, low-activity, and former PWID in Manipur, and heterosexual sexual partners of current and former PWID. IDU-Manipur also models hepatitis C virus (HCV) transmission through unsafe injecting and HCV-related liver disease progression. The model simulates the impact of immediate ART and expanded access to current PWID and both current and former PWID.

None of the models for India simulate an ART eligibility threshold of CD4 ≤500 cells/μL, only immediate eligibility for key populations compared to current eligibility guidelines.

In Vietnam, the Prevtool model represents the entire aged 15–49 population of Vietnam, categorised into eight distinct groups: direct and indirect FSW, male clients of FSW, MSM, male and female PWID, and the remaining males and females who are not members of these populations. The model simulates immediate ART eligibility with status quo and prioritised expanded access for each of FSW, MSM, and PWID, and immediate eligibility and expanded access for all three of these groups simultaneously. It also simulates ART eligibility for CD4 ≤500 cells/μL for all adults, with prioritised expanded access for these three groups.

1.1.3 Model assumptions about ART

HIV infectiousness

Table S2 summarises the assumptions made by each model about the infectiousness of a typical HIV-positive person during each CD4 cell count stage for persons on ART and not on ART, relative to the infectiousness of an untreated person with CD4 350–500 cells/μL. For some models (STDSIM, EMOD, Synthesis) CD4 count is not directly related to infectiousness; values in the table represent derived approximate values for relative infectiousness for persons in each CD4 category.

Table S2: HIV infectiousness relative to untreated person with CD4 350–500 cells/μL

	Not on ART					On ART			
Model	**Primary Infection**	**CD4 >500**	**CD4 350-500**	**CD4 200-350**	**CD4 ≤200**	**CD4 >500**	**CD4 350-500**	**CD4 200-350**	**CD4 ≤200**
Goals	15.9	1.0	(reference)	1.0	4.8	0.08	0.08	0.08	0.08
STDSIM	8.6	1.0	(reference)	1.7	2.7	0.10	0.10	0.30	0.75
EMOD	26.7	1.0	(reference)	1.0	7.3	0.08	0.08	0.08	0.08
BBH	9.0	1.0	(reference)	1.0	7.5	0.04	0.04	0.04	0.04
PopART	26.0	1.0	(reference)	1.0	2.3	0.10	0.10	0.10	0.23
Synthesis[a]	5.9	0.9	(reference)	1.2	1.4	0.02	0.05	0.13	0.33
Menzies	N/A	1.0	(reference)	7.3	7.3	0.04	0.04	0.29	0.29
Macha	27.0	1.0	(reference)	1.0	3.5	0.03	0.03	0.03	0.03
Pruddell	18.5	1.0	(reference)	1.0	3.4	0.05	0.05	0.05	0.05
Mishra	5.0	1.0	(reference)	1.4	5.0	0.04	0.04	0.04	0.04
IDU-Manipur	25.0	1.0	(reference)	1.0	7.6	0.10	0.10	0.10	0.10
Prevtool	1.6	1.6	(reference)	1.0	3.8	0.04	0.04	0.04	0.04

[a] For the Synthesis model, HIV infectiousness is a function of individual HIV viral load, thus the values in the table reflect the viral load distribution in the ART / CD4 category. The rates per partnership per three month period are 0.0001 (VL <500), 0.01 (VL 500–5,000), 0.03 (VL 5,000–50,000), 0.06 (VL 50,000–500,000), 0.1 (VL >500,000). Viral load for untreated individuals varies and increases as HIV infection progresses. For persons on ART, around 90% are virally suppressed, conferring a transmission rate of 0.0001 per 3 month period.

Effect of ART on mortality/survival

Table S3 summarises models' assumptions about the therapeutic benefits of ART for HIV-positive persons with different cell counts.

Table S3: Model assumptions about the therapeutic benefits of ART

Model	Summary of therapeutic effects of ART
Goals	The effect of ART on mortality varies by age, sex, CD4 count at ART initiation, and duration on ART (< 6 mos, 6-12 mos, > 12 mos). ART has no effect on mortality for persons with CD4 >500 cells/μL. For persons with CD4 350-500 cells/μL, ART has no effect on mortality rates in the first year, and reduces mortality by around 25% thereafter. For persons with CD4 200-350 cells/μL, ART reduces mortality by around 55–85% after one year. For persons with CD4 ≤200 cells/μL, ART reduces the mortality rate by 45–80% in the first year, and by over 90% thereafter. Full details are available from the Spectrum model: http://www.futuresinstitute.org/spectrum.aspx
STDSIM	Untreated HIV-positive persons progress through six symptom-based stages: acute infection, two asymptomatic stages, 2 symptomatic stages, and AIDS. Persons on ART progress through the same stages as uninfected persons, at a 4 times slower rate after initiating treatment.
EMOD	HIV-positive persons proceed through three infectious stages (acute, asymptomatic, and AIDS), and CD4 count declines linearly until death. Survival after ART initiation depends on CD4 count category (25–49, 50–99, 100–199, 200+ cells/μL), age, sex, and presence of WHO Stage III/IV clinical disease. There is no additional survival benefit for persons initiating CD4 >350 cells/μL compared to persons with CD4 200-350 cells/μL. Full details are available: http://arxiv.org/pdf/1206.3720.pdf
BBH	Untreated HIV-positive persons experience mortality rates of 0.049 per year (CD4 >350 cells/μL), 0.077 per year (CD4 200–350 cells/μL), and 0.237 per year (CD4 ≤200 cells/μL). The mortality rate is reduced to 0.027 per year for all persons on ART.
PopART	Untreated HIV-positive persons proceed through primary infection followed by four CD4 cell count stages (CD4 >500, 350–500, 200–350, ≤200). Persons on ART progress through the same stages as uninfected persons, at a 2 times slower rate after initiating treatment.
Synthesis	Risk of mortality depends on CD4 cell count, viral load, age, and being on ART. Persons on ART experience a 20% reduction in mortality compared to similar persons not on ART, plus additional reductions commensurate with the suppression of viral load. Toxicities related to specific antiretroviral drugs effect small additional risks of mortality (neophrotoxicity associated with tenofovir, pancreatitis associated with didanosine or stavudine, and lactic acidosis associated with didanosine, stavudine or zidovudine). Taken together, there is a modest therapeutic benefit for ART initiation at CD4 count of 500 cells/μL versus CD4 count of 350 cells/μL (36% died after 20 years vs. 40% died after 20 years).
Menzies	For persons with CD4 >350 cells/μL, ART reduces the HIV-specific mortality rate from 0.0083 per year for untreated persons to 0.0080 per year. For those with CD4 200–350 cells/μL, ART reduces the mortality rate from 0.030 per year to 0.025 per year. For those with CD4 ≤200 cells/μL, ART reduces the mortality rate from 0.257 per year to 0.051 per year. Additional mortality results from TB disease. TB disease incidence increases for untreated persons at lower CD4 cell counts, and ART reduces the incidence of TB disease.
Macha	Untreated HIV-positive persons with CD4 >200 cells/μL experience a mortality rate of 0.098 per year. After initiating ART, mortality is reduced to 0.068 per year for the first 3 months, to 0.051 per year for three to six months on ART, and 0.041 per year after six months on ART. Untreated persons with CD4 ≤200 cells/μL experience mortality at a rate of 0.63 per year. After ART initiation, mortality is reduced to 0.19 per year, 0.063 per year, and 0.06 per year for <3 months, 3–6 months, and 6+ months on ART.
Pruddell	Untreated HIV-positive persons proceed through acute infection followed by three CD4 count stages (CD4 >350, 200–350, ≤200 cells/μL). Persons on ART proceed through the stages at 1/3 the rate of untreated persons.
Mishra	For persons with CD4 >350 cells/μL, mortality is reduced from 0.025 per year for untreated persons to 0.0032 per year for treated persons. For those with CD4 200–350 cells/μL, mortality is reduced from 0.08 per year to 0.01 per year when treated. For those with CD4 ≤200 cells/μL, mortality is reduced from 0.5 per year to 0.05 per year when treated. Full reductions in mortality are only realised after the first year; during the first year on ART reductions in mortality are half that ultimately achieved.
IDU-Manipur	Untreated HIV-positive persons proceed through acute infection followed by three CD4 count stages (CD4 >350, 200–350, ≤200 cells/μL). Persons on ART proceed through the stages at 1/3 the rate of untreated persons.
Prevtool	HIV positive persons experience mortality rates depending on their CD4 cell count: 0.0005 per year (CD4 >500 cells/μL), 0.00128 per year (CD4 350–500 cells/μL), 0.011 per year (CD4 200–350 cells/μL), and 0.5 per year (CD4 < 200 per year). Persons on ART reconstitute their CD4 cell count and increase to higher CD4 count categories, thereby reducing their mortality risk.

Retention on ART and re-initiation

Table S4 summarises models' assumptions about the therapeutic benefits of ART for HIV-positive persons with different cell counts. In this study, models did not assume that persons initiating ART with higher CD4 cell counts have poorer adherence or retention.

Table S4: Model assumptions about retention on ART and re-initiation on ART after dropping out

Model	Summary of model assumptions about retention on ART
Goals	Model does not explicitly simulate dropout from ART
STDSIM	Persons on ART stop treatment at a rate of 0.05 per year. Persons who have dropped out from treatment reinitiate treatment at half the rate of ART naïve persons.
EMOD	Persons on ART stop treatment at a rate of 0.1 per year. Half of persons can re-enter care and reinitiate ART at the same rate as treatment naïve individuals. The other half can only re-initiate when experiencing symptoms, or when brought to care by an HIV-positive partner undergoing pre-ART monitoring (which occurs at low-levels in the baseline model calibration), or when attending antenatal care.
BBH	Model does not explicitly simulate dropout from ART.
PopART	All persons on ART stop treatment at a dropout rate of 0.05 per year. Persons who have dropped out of treatment reenter care and reinitiate treatment at the same rate as treatment naïve persons in the same CD4 category.
Synthesis	Persons on ART experience an annual rate of interrupting ART of 0.08 for people without toxicity and optimal adherence, up to 0.32 for people with toxicities and poor average adherence (below 50%) . People who interrupted ART experience a 0.4 rate per 3 months of being lost from care. Those who interrupted ART but who are still in care experience 0.4 probability of restarting tretament while people lost from care experience a rate of 0.1 per 3 months of returning to care.
Menzies	Model does not explicitly simulate dropout from ART.
Macha	Persons on ART stop treatment at a rate of 0.05 per year. Persons who have dropped out reinitiate ART at the same rate as persons in pre-ART care.
Pruddell	Persons on ART stop treatment at a rate of 0.064 per year. Persons who have dropped out are eligibile to reinitiate treatment after their CD4 cell count falls below CD4 ≤200 cells/μL, with the rate depending on the symptomatic stage: 0.01 per year for CD4 ≤200 and asymptomatic, 0.03 per year for symptomatic pre-AIDS, and 0.08 per year for those with AIDS.
Mishra	Persons on ART discontinued treatment or experienced virological treatment failure at a rate of 7% in the first year on treatment, and 1% per year thereafter. Persons who have dropped out from ART reinitiate ART based on experience of clinical symptoms at the same rate as ART naïve persons.
IDU-Manipur	Persons on ART stop treatment at a rate of 0.1 per year. Persons who have dropped out from ART are not eligible to re-initiate treatment until they reach the AIDS stage.
Prevtool	Persons on ART dropout or discontinue treatment due to treatment failure at a rate of 0.05 per year. Persons who have dropped out from ART recommence ART at a rate of 0.07 per year.

Adherence and resistance

Two models, Prevtool and Synthesis, explicitly model viraemia related to poor adherence and the development of resistance (see Synthesis model for details[4]. This viraemia increases the risk of clinical progression and mortality as well as the risk of resistance. Other models implicitly account for incomplete viral suppression related to poor adherence or resistance by assuming a persistent low risk of HIV transmission for persons on ART (Table S2).

Behaviour change in response to ART

Models did not assume any changes in population-level sexual risk behaviour in the general population (e.g. 'risk compensation') in response to earlier ART eligibility or expanded ART access.

Two models (Synthesis and Macha) assumed modest reductions in sexual risk behaviour among HIV positive persons after being diagnosed with HIV. The other models did not assume changes in sexual behaviour upon receiving a positive HIV diagnosis. The Synthesis model assumes receiving a positive HIV diagnosis reduces the probability of having condom-less sex in the first 6 months after diagnosis by 13% with a primary partner and by 17% with a casual partner. After the first six months, the reduction is 9%. The Macha model assumes that the contact rate for HIV-positive persons is reduced by 18.6% after receiving an HIV diagnosis..

Two other models (STDSIM and Pruddell) assumed that HIV positive persons in advanced disease stages have reduced sexual risk behaviour. The STDSIM model assumes a 50% reduction in the frequency of sexual contact within regular partnerships for persons in the AIDS stage, while Pruddell assumes cessation of all new sexual contacts for persons with symptomatic AIDS. Sexual activity returns to normal levels upon ART initiation.

1.2 Outputs reported by epidemiological models

Epidemiological models reported standardised outputs for each ART eligibility and access strategy that were used for calculation of the incremental costs and health benefits. All models reported the following outputs for the population at the midpoint of each year from 2014 through 2033:

- The total size of the adult (age 15+) population.
- The total number of HIV- adults.
- The number of HIV+ adults not in pre-ART care with CD4 >350 cells/μL.
- The number of HIV+ adults not in pre-ART care with CD4 200–350 cells/μL.
- The number of HIV+ adults not in pre-ART care with CD4 ≤200 cells/μL.
- The number of HIV+ adults in pre-ART care with CD4 >350 cells/μL.
- The number of HIV+ adults in pre-ART care with CD4 200–350 cells/μL.
- The number of HIV+ adults in pre-ART care with CD4 ≤200 cells/μL.
- The number of HIV+ adults on ART

All models also reported the following outputs about the number of events occurring during the calendar year (1 January to 31 December) annually from 2014 through 2033:

- The number of new adult HIV infections.
- The number of infected adults entering pre-ART care.
- The number of HIV diagnostic tests conducted (except BBH, PopART, and IDU-Manipur, see section 1.3.1(c)).
- The number of adults initiating ART from pre-ART care.
- The number of adults initiating ART not from pre-ART care.
- The number of adult deaths.

Midyear population sizes were used as an approximation for person-years lived in each state for the calculation of rates. Models which simulated specific populations (FSW, MSM, PWID) reported the number of diagnostic tests and number of persons entering pre-ART care within each of these populations.

Models which simulated TB disease reported:

- The number of adults with TB disease at midyear.
- The number of TB cases treated during the calendar year.

The IDU-Manipur model, which also included hepatitis C virus (HCV) transmission among PWID, reported the number of adults infected with HCV stratified according to the following disease stages: mild/moderate HCV, compensated cirrhosis, decompensated cirrhosis, and hepatic carcinoma. The following disability weights were associated with these four stages: 0.036, 0.123, 0.194, 0.484.[5] No additional health costs were associated with HCV infection due to the lack of availability of HCV treatment in this setting.

1.3 Estimation of incremental costs associated with ART policy changes

1.3.1 General approach

Costs were assessed incrementally, and any programme area (or similar category of resource consumption) which was thought to be unaffected by the changes in ART policy examined in this analysis were not included in the costing. The following broad categories were included in the cost assessment:

(a) service delivery costs for individuals receiving ART,

(b) service delivery costs for individuals receiving pre-ART care,

(c) service delivery costs required to identify and link HIV-positive individuals to care,

(d) cost savings due to reduced healthcare utilisation in the routine health system, and

(e) costs of higher-level programmatic support and supply-chain management.

The general framework for calculating total costs for each of these areas was to (i) describe the relevant units of service delivery, (ii) estimate the unit costs for delivering those services, (iii) estimate the quantity of services provided, and (iv) combine these estimates to calculate total service delivery costs.

ART costs

ART costs were subdivided into ARV costs and non-ARV costs. In general the models in this analysis did not model the receipt of individual regimens by patients, and therefore ARV costs were modeled as an overall average. Under each strategy, the total costs of ARV drugs in a given year were calculated by multiplying the number of person-years of ART in that year (estimated as ART patient volume at midyear) by the average annual cost of an ART regimen. Regimen distributions, including both first- and second-line ARV regimens, were based on reported data for each country, thus reflecting current prescribing practices. Prices for each regimen were calculated using average drug prices obtained from the WHO Global Price Reporting System[6]. The average annual regimen cost was calculated as the weighted average cost across all first- and second-line regimens.

Non-ARV service delivery costs were subdivided into ART initiation costs and established patient costs. Under each strategy, the ART initiation costs—accounting for the additional laboratory tests and clinic visits incurred during a patient's initial months on ART—were calculated by multiplying the number of individuals initiating ART in a given year by the ART initiation unit cost, which was obtained from an evidence synthesis of available costing data. For patients who were not in pre-ART care before ART initiation, ART initiation costs include an additional cost of an HIV diagnostic test and CD4 cell count measurement, which will have been accounted for in HIV testing & linkage costs and pre-ART care costs (see below) for those patients who initiate ART after being in pre-ART care. Establish patient costs—accounting for the regular clinical care and laboratory monitoring received by ART patients, as well as all other site-level activities required for the functioning of the ART programme—were calculated by multiplying the number of person-years of ART in that year (estimated as ART patient volume at midyear) by the established ART patient unit cost, obtained from an evidence synthesis of available costing data. Non-ARV service delivery costs were calculated as the sum of initiation and establish patient costs, and total ART costs calculated as the sum of ARV and non-ARV costs.

Pre-ART costs

Pre-ART patients receive regular clinical and laboratory monitoring to assess their eligibility for ART initiation, as well as prophylaxis and treatment of opportunistic infections, and other HIV care services provided by the HIV treatment programme. Under each strategy, the total costs of pre-ART care in a given year were calculated by multiplying the number of person-years of pre-ART in that year (estimated as pre-ART patient volume at midyear) by the pre-ART patient unit cost, obtained from an evidence synthesis of available costing data.

HIV testing costs

The strategies in these analyses focused on various approaches for providing HIV treatment, and some of these approaches (particularly the expanded access strategies) required a substantial acceleration in the rate at which HIV-positive individuals are identified for care and treatment. Most models included mechanistic representations of the volume of HIV testing required to achieve the levels of ART scale-up specified for each healthcare access strategy. For those models which reported testing volumes (Goals, STDSIM, EMOD, Synthesis, Menzies, Macha, Pruddell, Mishra, and Prevtool), total testing costs for a given year were calculated by multiplying the total number of individuals receiving an HIV test during the year by the VCT unit cost, which was obtained from an evidence synthesis of available costing data. For models which did not have a mechanism for estimating testing volume (BBH, PopART, IDU-Manipur), we developed a simple function for estimating testing costs based on (i) the rate at which HIV-positive adults who were not in care entered care in each year, (ii) a multiplier to account for loss-to-follow-up between HIV testing and HIV care, and (iii) the VCT unit cost. We estimated the rate of entering care as the number of people initiating HIV care in a given year divided by the total HIV positive population not yet receiving pre-ART or ART at midyear. This rate is multiplied by the average number of diagnoses per person entering care, taken to be 1.7 based on the results of a systematic review and meta-analysis,[7] to estimate the rate of HIV testing among persons living with HIV who are not in care. This testing rate is converted to an annual probability of being tested for adults living with HIV. It was assumed that HIV-negative adults were 0.65 times as likely to be tested as infected adults,[8,9] and the annual percentage of HIV-negative adults testing was estimated as the testing percentage of infected adults times this factor. The total annual testing volume was obtained by multiplying the number of adults living with HIV who are not on ART or in pre-ART care and the number of HIV-negative adults by their annual testing percentages. Total testing costs for a given year were calculated by multiplying the testing volume for that year by the VCT unit cost. For models to which this was applied that included key populations (BBH: FSW, MSM; IDU-Manipur: PWID), the rate of testing was calculated separately for these populations and for the general population who were not part of these populations. For key populations (FSW, MSM, PWID), an additional component was added to the unit cost to represent the additional costs required for outreach to these groups.

Cost savings in the general health system

The cost categories described above capture the costs incurred within an HIV programme for identification, care and treatment of HIV-positive individuals. Even if not identified and linked to an HIV treatment programme, an individual with HIV will exhibit greater health care utilisation, the costs of which will be eliminated when the individual begins receiving their care from an HIV

treatment programme. These other care costs were subdivided into an annual healthcare utilisation cost and end-of-life care costs.

Annual healthcare utilisation costs were estimated for the individuals with untreated HIV (CD4 cell count categories >350 cells/μL , 200–350 cells/μL and ≤200 cells/μL). Annual healthcare utilisation costs for an individual with untreated, HIV were estimated from annualised frequencies of outpatient visits and inpatient days[10] adjusted for the different rates of opportunistic infection observed with each CD4 category[11–13] multiplied by estimates of the unit costs of outpatient visits and inpatient days obtained from WHO CHOICE[14]. Under each strategy, the total healthcare utilisation costs in a given year were calculated by multiplying the number of person-years of untreated HIV with CD4 >350 cells/μL, CD4 200–350 cells/μL, and CD4 ≤200 cells/μL (estimated as the total number of individuals in those categories at midyear) by the annualised cost for each of these categories. For the subset of models which modelled changes in TB service utilisation as a function of HIV policy (Goals, EMOD, Menzies), these changes in TB control cost were estimated as the total number of individuals receiving TB treatment in a given year multiplied by the unit cost of a course of TB treatment obtained from an evidence synthesis of available costing data.

End-of-life care costs were assumed to be the same for all individuals. For each strategy, total end-of-life care costs were estimated as the number of inpatient days incurred by HIV positive individuals in the 6 months preceding death,[10] multiplied by the unit cost per inpatient day obtained from WHO-CHOICE[14], multiplied by the total number of individuals dying in a given year.

Programmatic support and supply-chain management

Programme costs—the costs of management, administration, training, M&E and other activities undertaken to support direct service provision—are a poorly understood component of HIV treatment programmes, but can represent a non-trivial fraction of total costs. Estimates of programme costs for PMTCT services suggest that these costs can represent 4–18% of total programme costs, and from 34–97% of total costs for HIV education services.[15] For this the purposes of this costing programme costs were subdivided into supply-chain management costs general programmatic support. Supply chain management (SCM) costs were estimated as a fixed mark-up on top of the total costs of ARVs, covering insurance, transportation, storage and distribution of ARV drugs as well as other SCM planning and management activities. This mark-up was estimated at 20% based on consultation with ARV supply chain experts (Elliot Raizes (US CDC), Joel Kuritsky (USAID), personal communication December 14th 2012). General programmatic support was estimated as a 50% mark-up on top of direct non-ARV service provision costs (i.e. representing 33% of the total non-ARV service provision cost) based on input of costing and programmatic experts attending the model harmonisation meeting held for this project in London, November 2012.

1.3.2 Evidence synthesis for unit cost estimates

A number of the unit costs used for this analysis were derived from an evidence synthesis of available costing data. For some countries, empirical costing data were not available for all of the different unit costs needed for the analysis. In other countries, multiple estimates were available for a given unit cost. This evidence synthesis adopted a Bayesian meta-analysis approach[16,17] to pool data within data rich settings, and to provide reasonable unit cost estimates for settings were empirical data were not available. Empirical data were gathered from costing studies conducted in the countries included in this analysis and similar settings, from the published literature, summary

reports, and from unpublished estimates from recently completed studies. Estimates were inflated to 2012 price levels using the GDP deflator in each country[18] and converted to US dollars at market exchange rates. These adjusted estimates were combined in a generalised linear mixed effects regression to control for differences in price level between countries and for historical time trends in unit cost associated with economies of scale and programme maturation. Weakly informative priors were used for model parameters, and the error distribution for logged costs was based a t-distribution to allow for outliers in the empirical cost estimates. This analysis was used to estimate unit cost for each service in each country. Point estimates and credible intervals for all unit costs, including those derived from the evidence synthesis, are shown in Table S5. A list of sources used in the evidence synthesis is given in Table S6.

Table S5: Posterior mean (95% credible interval) unit cost estimates (2012 US dollars)

	South Africa	Zambia	India	Vietnam
ART: ARV drug costs	143 (107 - 179)	141 (106 - 176)	91 (68 - 114)	105 (99 - 165)
ART: non-ARV costs, initiation (previously receiving pre-ART)	95 (68 - 125)	49 (33 - 65)	29(19 - 41)	45 (35 - 56)
ART: non-ARV costs, initiation (previously untreated patient)	126 (88 - 175)	65 (42 - 92)	38 (25 - 57)	59 (45 - 79)
ART: non-ARV costs, established patient	422 (317 - 494)	217 (138 - 276)	128 (86 - 171)	198 (161 - 245)
Pre-ART: CD4 > 350	205 (115 - 281)	127 (58 - 182)	73 (36 - 112)	145 (110 - 186)
Pre-ART: CD4 200 - 350	238 (142 - 319)	139 (69 - 196)	81 (43 - 121)	150 (114 - 192)
Pre-ART: CD4 < 200	359 (267 - 434)	185 (116 - 239)	109 (72 - 148)	169 (134 - 210)
HIV testing	20 (14 - 26)	10 (6 - 14)	6 (4 - 9)	9 (7 - 12)
Cost of identifying high risk populations (FSW, MSM, PWID)	67 (46 - 93)	34 (21 - 49)	20 (14 - 29)	31 (23 - 41)
Healthcare utilisation cost for HIV positive, untreated, CD4 > 350	13 (6 - 20)	5 (2 - 8)	3 (1 - 5)	2 (1 - 3)
Healthcare utilisation cost for HIV positive, untreated, CD4 200 - 350	46 (33 - 58)	17 (13 - 22)	11 (8 - 14)	7 (5 - 9)
Healthcare utilisation cost for HIV positive, untreated, CD4 < 200	167 (158 - 173)	63 (60 - 65)	39 (37 - 41)	26 (25 - 27)
TB treatment	364 (253 - 499)	188 (111 - 273)	110 (66 - 166)	172 (114 - 245)
End-of-life care	160 (68 - 248)	50 (21 - 77)	34 (15 - 53)	32 (13 - 49)
Supply chain management (%, multiplier on ARV costs)	20% (15% - 25%)	20% (15% - 25%)	20% (15% - 25%)	20% (15% - 25%)
Programmatic support (%, multiplier on non-ARV costs)	50% (25% - 75%)	50% (25% - 75%)	50% (25% - 75%)	50% (25% - 75%)

Table S6: Sources used for evidence synthesis of unit costs

Data Source	Countries	Unit Costs	Citation
Cleary 2006	South Africa	Established ART	[10]
Deghaye 2006	South Africa	Established ART	[19]
John 2006	India	Established ART	[20]
McConnel 2006	South Africa	HIV testing	[21]
Thielman 2006	Tanzania	HIV testing	[22]
Bassett 2007	South Africa	HIV testing	[23]
Fung 2007	India	Outreach to high-risk groups	[24]
Harling 2007	South Africa	Established ART	[25]
Dandona 2008	India	Outreach to high-risk groups, HIV testing	[26]
Dowdy 2008	South Africa, Brazil, Kenya	TB treatment	[27]
Hounton 2008	Benin	Established ART	[28]
Rosen 2008	South Africa	Established ART	[29]
Vella 2008	South Africa	Established ART	[30]
Aldridge 2009	Peru	Outreach to high-risk groups	[31]
Bikilla 2009	Ethiopia, Uganda	Established ART	[32]
Dandona 2009	India	Outreach to high-risk groups	[33]
Gupta 2009	India	Established ART	[34]
Martinson 2009	South Africa	Pre-ART, ART initiation, established ART	[35]
Menzies 2009	Uganda	HIV testing	[36]
Negin 2009	Kenya	HIV testing	[37]
Bratt 2010	Zambia	HIV testing, ART initiation	[38]
Datiko 2010	Ethiopia	TB treatment	[39]
Grabbe 2010	Kenya	HIV testing	[40]
Long 2010	South Africa	Established ART	[41]
Steffen 2010	Brazil	TB treatment	[42]
Tumwesigye 2010	Uganda	HIV testing	[43]
CDC 2011a	Mozambique	Pre-ART, ART initiation, established ART	[44]
CDC2011b	Tanzania	Pre-ART, ART initiation, established ART	[45]
Chandrashekar 2011	India	Outreach to high-risk groups	[46]
Kahn 2011	Uganda, Kenya	HIV testing	[47]
Menzies 2011	Botswana, Ethiopia, Nigeria, Uganda, Vietnam	Pre-ART, ART initiation, established ART	[48]
Prado 2011	Brazil	TB treatment	[49]
Rosen 2011	Ghana	Established ART, Pre-ART	[50]
Samandari 2011	Botswana	TB treatment	[51]
Vassall 2011	South Africa, India, Uganda	TB treatment	[52]
Aliyu 2012	Nigeria	HIV testing, established ART	[53]
CDC 2012	Kenya	Pre-ART, ART initiation, established ART	[54]
FHI 2012	Vietnam	Outreach to high-risk groups, HIV testing	Unpublished data
Marseille 2012	Zambia	Established ART	[55]
Menzies 2012	South Africa	TB treatment	[56]
Meyer-Rath 2012	South Africa	TB treatment	[57]
Minh 2012	Vietnam	Outreach to high-risk groups	[58]
Nichols 2012	Zambia	HIV testing	[59]
Obure 2012	Kenya, Swaziland	HIV testing	[60]
Pho 2012	India	TB treatment	[61]
Tran 2012a	Vietnam	Established ART	[62]
Tran 2012b	Vietnam	HIV testing, ART initiation	[63]
Thuy 2012	Vietnam	Pre-ART, ART initiation, established ART	[64]
CHAI 2013	Rwanda, Malawi, Ethiopia, Zambia, South Africa	Pre-ART, established ART	[65]

2 Supplementary results

2.1 Baseline model calibration

The following figures S1 – S5 illustrate the HIV epidemic projections for the baseline simulation assuming continuation of ART eligibility for CD4 ≤350 cells/µL and status quo access to care.

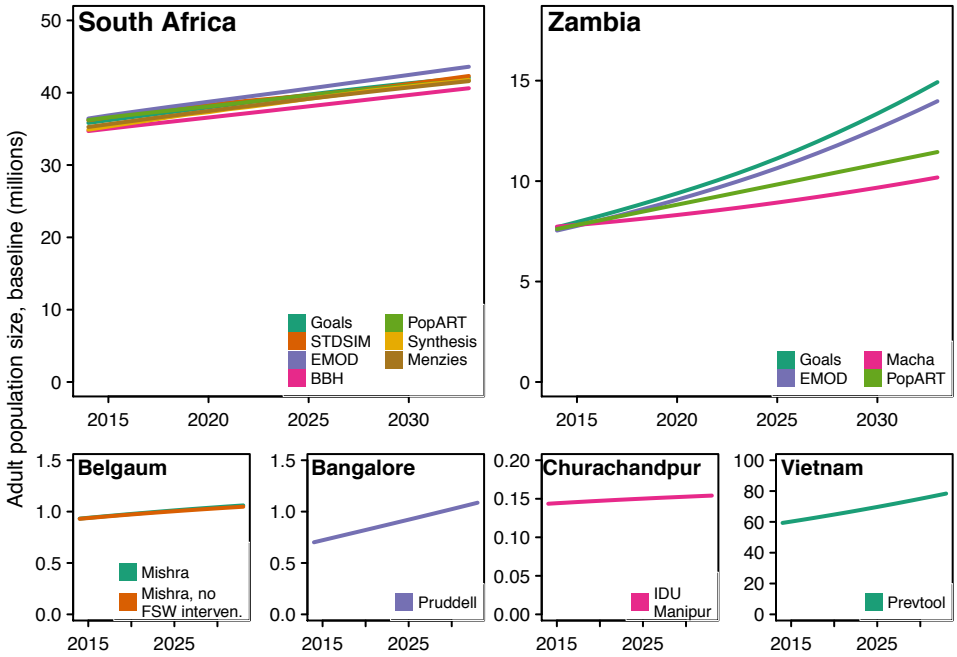

Figure S1: Total adult population size (in millions) for the baseline simulation, assuming eligibility for CD4 ≤350 cells/µL and status quo access to care.

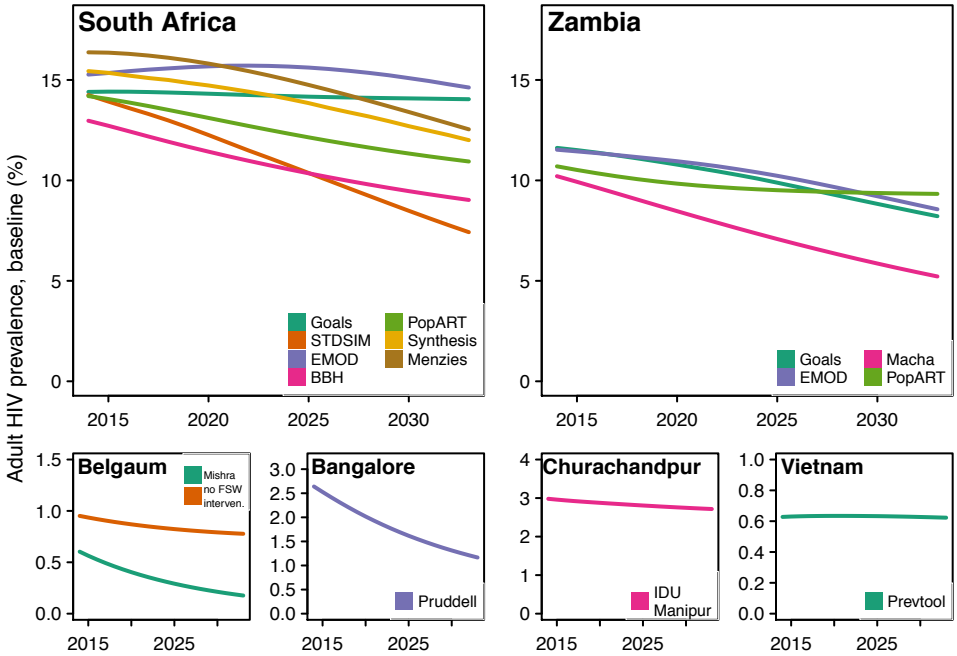

Figure S2: Adult HIV prevalence for the baseline simulation, assuming eligibility for CD4 ≤350 cells/µL and status quo access to care.

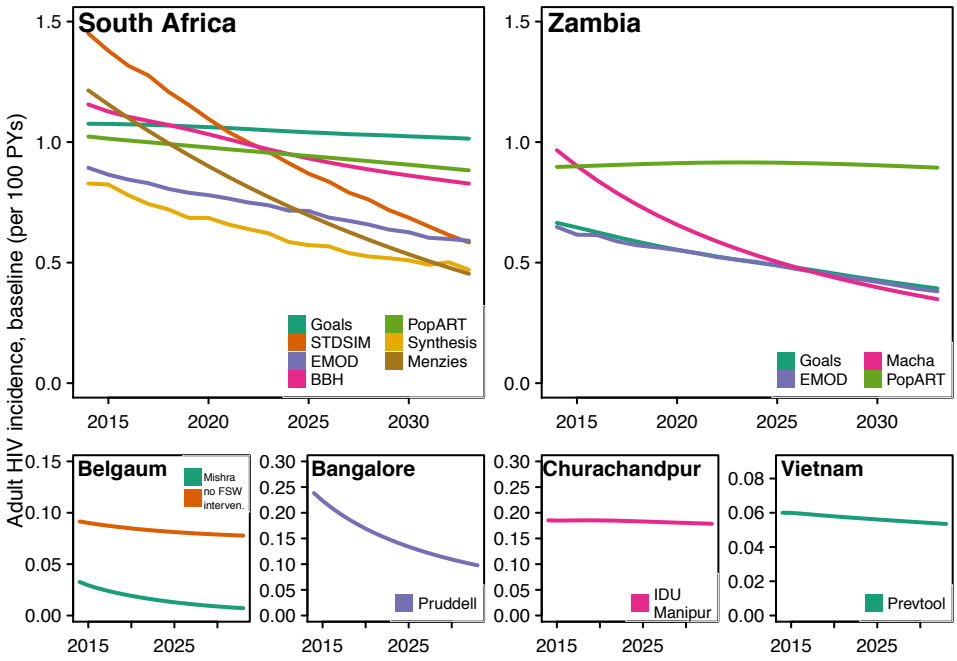

Figure S3: Adult HIV incidence rate per 100 person-years for the baseline simulation, assuming eligibility for CD4 ≤350 cells/μL and status quo access to care.

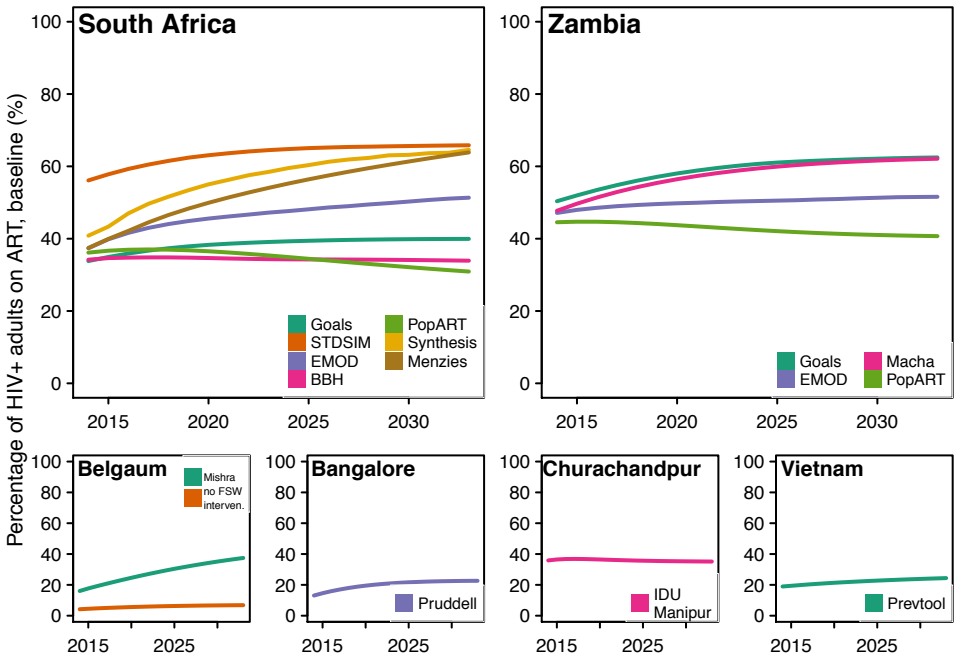

Figure S4: The percentage of adults living with HIV who are on ART for the baseline simulation, assuming eligibility for CD4 ≤350 cells/μL and status quo access to care.

2.2 The accumulation of health benefits and costs over time

The following figures illustrate how the health benefits and costs of each strategy accumulate over time.

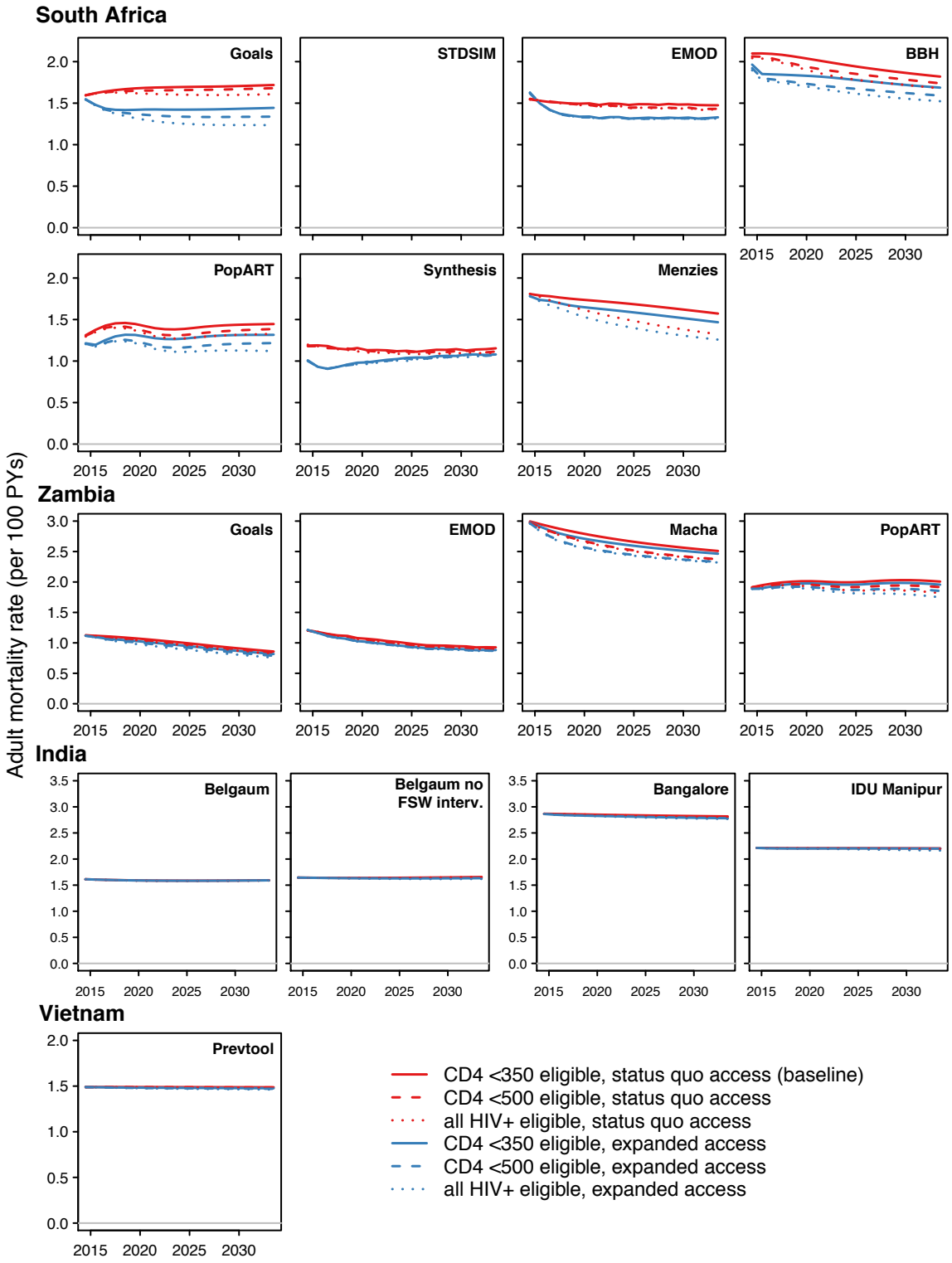

Figure S5: Annual adult mortality rate per 100 person-years. Strategies represented are the same as those in Figure 2.

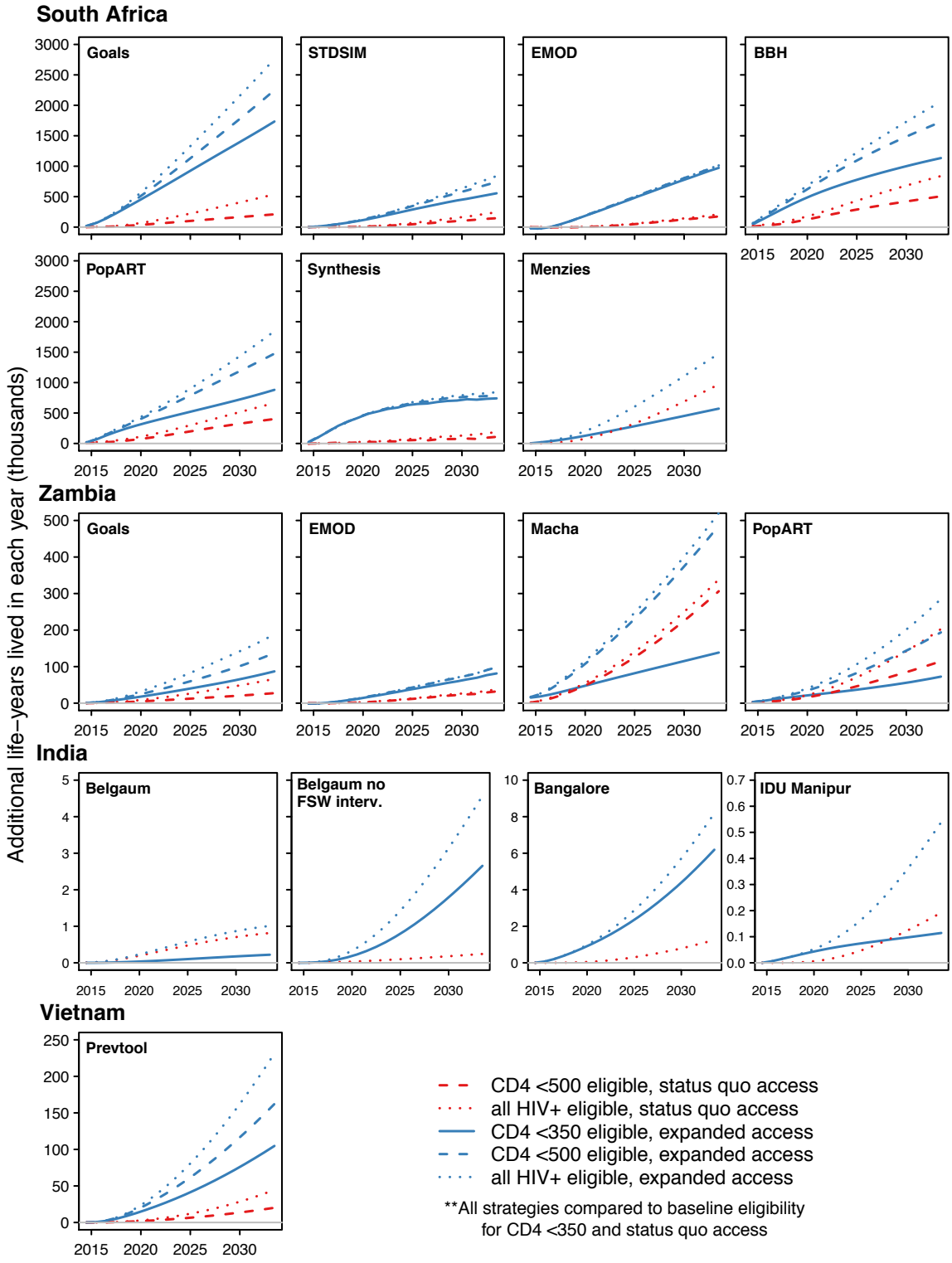

Figure S6: The additional life-years lived in each year (thousands, undiscounted) compared to baseline strategy of eligibility for CD4 ≤350 cells/μL and status quo access to care. Strategies represented are the same as those in Figure 2.

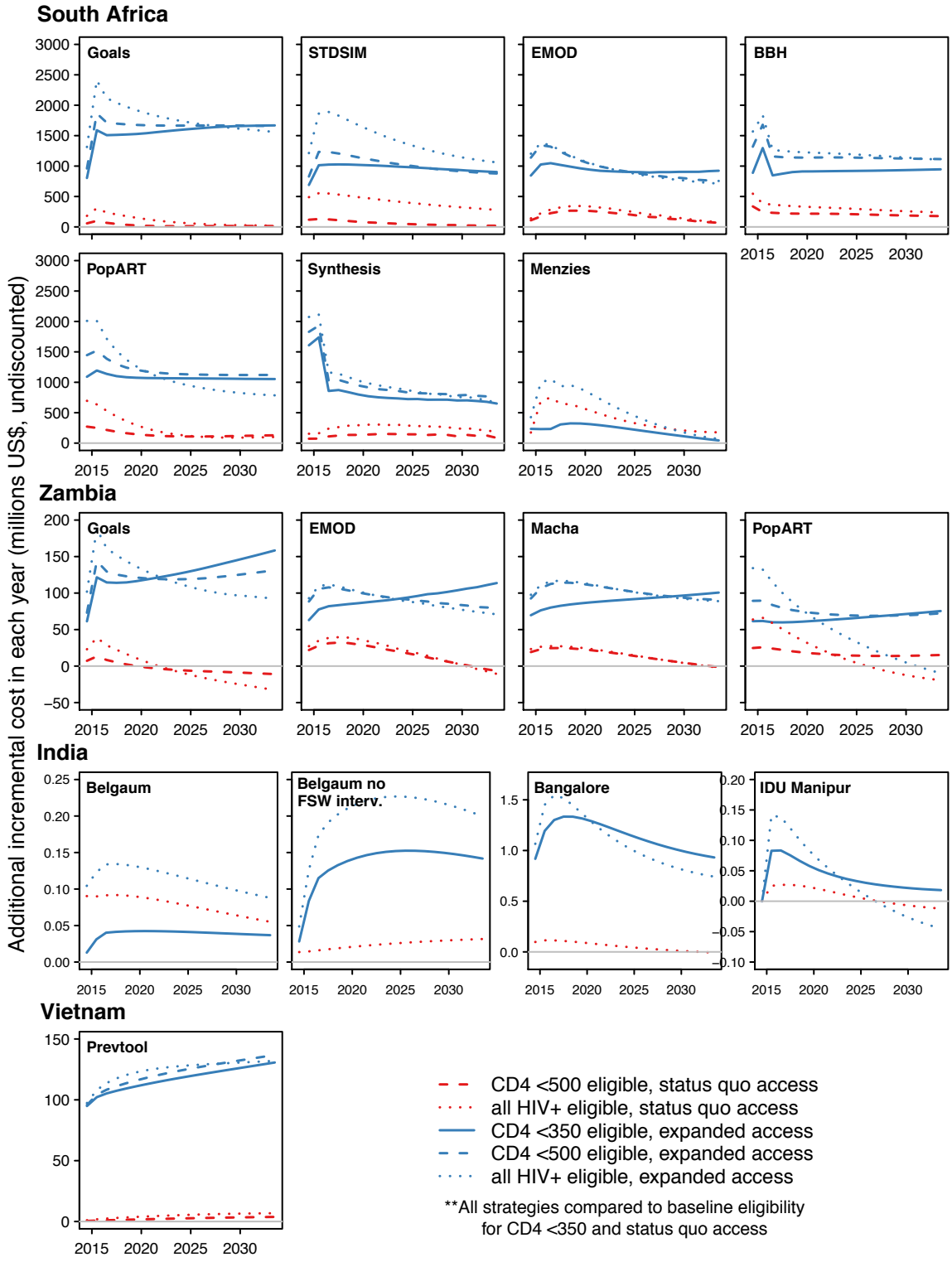

Figure S7: The incremental costs incurred in each year (millions US$, undiscounted) compared to baseline strategy of eligibility for CD4 ≤350 cells/μL and status quo access to care. Strategies represented are the same as those in Figure 2.

2.3 Incremental cost-effectiveness ratios for varied time horizons and discount rates

Table S7: Cost per DALY averted (2012 US$) comparing select strategies in models for South Africa

		5 years			10 years			20 years		
		0% disc.	3% disc.	6% disc	0% disc.	3% disc.	6% disc	0% disc.	3% disc.	6% disc
CD4 ≤500, status quo vs. CD4 ≤350, status quo	Goals	$2,073	$2,140	$2,208	$665	$735	$811	$221	$273	$336
	STDSIM	$4,708	$4,791	$4,873	$2,468	$2,620	$2,776	$748	$918	$1,117
	EMOD	$11,358	$11,646	$11,942	$4,156	$4,391	$4,642	$1,328	$1,560	$1,830
	BBH	$3,952	$4,063	$4,175	$1,655	$1,763	$1,879	$740	$839	$956
	PopART	$3,722	$3,771	$3,819	$1,714	$1,830	$1,950	$681	$790	$919
	Synthesis	$4,918	$4,982	$5,046	$2,835	$2,927	$3,025	$1,553	$1,691	$1,843
All HIV+, status quo vs. CD4 ≤350, status quo	Goals	$4,393	$4,525	$4,658	$1,370	$1,496	$1,630	$345	$438	$552
	STDSIM	$17,571	$17,869	$18,169	$9,530	$10,018	$10,525	$3,243	$3,790	$4,430
	EMOD	$12,319	$12,590	$12,867	$4,548	$4,801	$5,071	$1,436	$1,692	$1,989
	BBH	$4,434	$4,561	$4,690	$1,770	$1,894	$2,027	$689	$795	$922
	PopART	$4,869	$4,920	$4,968	$2,166	$2,334	$2,506	$660	$822	$1,015
	Synthesis	$8,106	$8,223	$8,341	$3,971	$4,131	$4,300	$1,925	$2,133	$2,367
	Menzies	$19,656	$20,120	$20,589	$4,540	$4,910	$5,310	$918	$1,132	$1,394
CD4 ≤350, expanded vs. CD4 ≤350, status quo	Goals	$4,123	$4,175	$4,226	$2,596	$2,685	$2,776	$1,502	$1,627	$1,767
	STDSIM	$6,994	$7,127	$7,263	$4,326	$4,492	$4,666	$2,475	$2,701	$2,954
	EMOD	$3,703	$3,749	$3,795	$2,390	$2,477	$2,566	$1,379	$1,505	$1,645
	BBH	$2,433	$2,476	$2,519	$1,617	$1,675	$1,736	$1,110	$1,187	$1,272
	PopART	$3,706	$3,764	$3,823	$2,518	$2,604	$2,692	$1,623	$1,750	$1,890
	Synthesis	$2,912	$2,978	$3,044	$1,844	$1,933	$2,025	$1,291	$1,398	$1,518
	Menzies	$2,688	$2,722	$2,757	$1,531	$1,594	$1,659	$588	$686	$796
CD4 ≤500 expanded vs. CD4 ≤350 status quo	Goals	$4,167	$4,227	$4,287	$2,388	$2,486	$2,587	$1,247	$1,371	$1,512
	STDSIM	$6,529	$6,648	$6,769	$3,973	$4,136	$4,305	$2,078	$2,303	$2,556
	EMOD	$4,462	$4,527	$4,592	$2,667	$2,784	$2,906	$1,357	$1,521	$1,705
	BBH	$2,791	$2,848	$2,905	$1,681	$1,755	$1,833	$1,012	$1,104	$1,208
	PopART	$3,757	$3,819	$3,880	$2,281	$2,380	$2,483	$1,251	$1,382	$1,528
	Synthesis	$3,218	$3,287	$3,356	$2,037	$2,134	$2,234	$1,375	$1,497	$1,632
All HIV+ expanded vs. CD4 ≤350 status quo	Goals	$4,775	$4,859	$4,942	$2,438	$2,560	$2,687	$1,110	$1,248	$1,407
	STDSIM	$9,451	$9,624	$9,800	$5,511	$5,755	$6,010	$2,627	$2,961	$3,335
	EMOD	$4,560	$4,629	$4,698	$2,693	$2,816	$2,943	$1,339	$1,508	$1,698
	BBH	$2,905	$2,968	$3,031	$1,688	$1,768	$1,852	$942	$1,040	$1,152
	PopART	$4,127	$4,197	$4,265	$2,253	$2,378	$2,507	$1,000	$1,153	$1,327
	Synthesis	$3,597	$3,677	$3,757	$2,185	$2,297	$2,413	$1,370	$1,514	$1,674
	Menzies	$6,780	$6,875	$6,969	$2,703	$2,874	$3,053	$696	$861	$1,054
All HIV+, status quo vs. CD4 ≤500, status quo	Goals	$7,729	$7,987	$8,250	$2,034	$2,223	$2,427	$432	$558	$713
	STDSIM	$75,694	$77,895	$80,145	$27,854	$29,729	$31,749	$7,700	$9,088	$10,772
	EMOD	$17,772	$17,824	$17,876	$6,875	$7,225	$7,591	$2,092	$2,498	$2,964
	BBH	$5,604	$5,770	$5,939	$2,033	$2,193	$2,365	$600	$717	$860
	PopART	$6,190	$6,229	$6,265	$2,802	$3,033	$3,264	$629	$870	$1,155
	Synthesis	$18,756	$19,110	$19,468	$6,234	$6,568	$6,927	$2,516	$2,856	$3,249
CD4 ≤500, expanded vs. CD4 ≤350, expanded	Goals	$4,504	$4,635	$4,766	$1,357	$1,477	$1,607	$309	$401	$512
	STDSIM	$4,818	$4,899	$4,980	$2,455	$2,619	$2,786	$585	$788	$1,022
	EMOD	$21,838	$22,397	$22,956	$8,315	$9,111	$9,944	$981	$1,814	$2,791
	BBH	$4,928	$5,080	$5,233	$1,941	$2,086	$2,243	$750	$872	$1,017
	PopART	$3,997	$4,072	$4,144	$1,440	$1,576	$1,718	$410	$509	$632
	Synthesis	$10,421	$10,518	$10,614	$5,721	$6,010	$6,305	$2,445	$2,815	$3,235
All HIV+, expanded vs. CD4 ≤350, expanded	Goals	$7,648	$7,901	$8,158	$2,017	$2,220	$2,439	$378	$516	$686
	STDSIM	$17,058	$17,313	$17,570	$9,472	$9,960	$10,460	$3,032	$3,666	$4,397
	EMOD	$22,832	$23,495	$24,159	$8,260	$9,103	$9,990	$720	$1,561	$2,555
	BBH	$4,822	$4,976	$5,133	$1,889	$2,037	$2,197	$641	$764	$912
	PopART	$5,232	$5,313	$5,390	$1,663	$1,873	$2,091	$127	$277	$463
	Synthesis	$22,301	$22,824	$23,340	$6,833	$7,423	$8,057	$1,974	$2,461	$3,043
	Menzies	$20,421	$20,867	$21,316	$4,582	$4,986	$5,421	$794	$1,024	$1,308
All HIV+, expanded vs. CD4 ≤500 expanded	Goals	$11,900	$12,340	$12,790	$2,780	$3,083	$3,412	$449	$636	$867
	STDSIM	$82,898	$84,726	$86,580	$34,080	$36,270	$38,586	$8,876	$10,809	$13,135
	EMOD	$36,267	$38,699	$41,267	$7,774	$9,030	$10,419	**A**	**A**	$733
	BBH	$4,594	$4,755	$4,918	$1,767	$1,923	$2,091	$422	$544	$694
	PopART	$6,793	$6,857	$6,915	$2,037	$2,364	$2,693	**A**	**A**	$189
	Synthesis	**B**	**B**	**B**	$9,622	$11,241	$13,208	$1,266	$1,901	$2,720

'**A**' indicates the policy listed first dominates the policy listed second (i.e. lower cost, greater health benefits). '**B**' indicates the policy listed second dominates the policy listed first.

Table S8: Cost per DALY averted (2012 US$) comparing selected strategies in models for Zambia

		5 years			10 years			20 years		
		0% disc.	3% disc.	6% disc	0% disc.	3% disc.	6% disc	0% disc.	3% disc.	6% disc
CD4 ≤500, status quo vs. CD4 ≤350, status quo	Goals	$1,253	$1,296	$1,339	$230	$290	$354	**A**	**A**	**A**
	EMOD	$5,448	$5,567	$5,687	$2,266	$2,406	$2,555	$595	$749	$926
	Macha	$1,270	$1,303	$1,336	$446	$477	$510	$105	$131	$163
	PopART	$2,301	$2,349	$2,397	$936	$1,002	$1,071	$311	$364	$429
All HIV+, status quo vs. CD4 ≤350, status quo	Goals	$2,612	$2,690	$2,768	$706	$802	$903	**A**	**A**	$77
	EMOD	$6,530	$6,681	$6,835	$2,535	$2,700	$2,876	$620	$790	$988
	Macha	$1,229	$1,262	$1,295	$433	$464	$497	$101	$128	$159
	PopART	$3,653	$3,751	$3,849	$1,134	$1,247	$1,368	$160	$237	$333
CD4 ≤350, expanded vs. CD4 ≤350, status quo	Goals	$5,227	$5,282	$5,336	$3,687	$3,788	$3,891	$2,333	$2,493	$2,670
	EMOD	$4,383	$4,436	$4,489	$2,834	$2,927	$3,024	$1,708	$1,836	$1,980
	Macha	$2,574	$2,601	$2,628	$1,757	$1,809	$1,862	$1,114	$1,193	$1,281
	PopART	$3,043	$3,089	$3,136	$2,106	$2,173	$2,243	$1,336	$1,436	$1,546
CD4 ≤500 expanded vs. CD4 ≤350 status quo	Goals	$4,161	$4,221	$4,280	$2,517	$2,614	$2,715	$1,365	$1,495	$1,643
	EMOD	$4,852	$4,925	$4,997	$2,778	$2,900	$3,026	$1,337	$1,496	$1,676
	Macha	$2,043	$2,079	$2,114	$1,021	$1,072	$1,125	$433	$489	$555
	PopART	$3,038	$3,098	$3,159	$1,606	$1,690	$1,778	$705	$796	$902
All HIV+, expanded vs. CD4 ≤350, status quo	Goals	$4,240	$4,317	$4,395	$2,165	$2,279	$2,398	$942	$1,073	$1,224
	EMOD	$4,953	$5,031	$5,109	$2,764	$2,892	$3,024	$1,273	$1,437	$1,622
	Macha	$1,970	$2,006	$2,041	$970	$1,020	$1,072	$406	$460	$523
	PopART	$3,467	$3,554	$3,642	$1,404	$1,516	$1,635	$331	$431	$551
All HIV+, status quo vs. CD4 ≤500, status quo	Goals	$4,534	$4,678	$4,823	$1,160	$1,298	$1,447	**A**	$57	$186
	EMOD	$39,639	$42,346	$45,317	$5,139	$5,618	$6,149	$788	$1,080	$1,436
	Macha	$979	$1,012	$1,046	$336	$367	$401	$71	$96	$127
	PopART	$6,260	$6,474	$6,692	$1,449	$1,642	$1,849	**A**	$69	$205
CD4 ≤500, expanded vs. CD4 ≤350, expanded	Goals	$1,623	$1,674	$1,726	$373	$435	$500	**A**	**A**	**A**
	EMOD	$7,415	$7,610	$7,806	$2,519	$2,771	$3,037	**A**	$160	$455
	Macha	$1,317	$1,352	$1,387	$426	$460	$496	$80	$108	$141
	PopART	$3,025	$3,121	$3,219	$844	$933	$1,029	$143	$197	$266
All HIV+, expanded vs. CD4 ≤350, expanded	Goals	$2,921	$3,016	$3,113	$731	$832	$939	**A**	**A**	$51
	EMOD	$7,830	$8,058	$8,288	$2,472	$2,741	$3,025	**A**	$56	$357
	Macha	$1,263	$1,297	$1,333	$408	$442	$477	$75	$102	$135
	PopART	$4,123	$4,281	$4,442	$768	$905	$1,054	**A**	**A**	**A**
All HIV+, expanded vs. CD4 ≤500 expanded	Goals	$4,580	$4,739	$4,899	$1,111	$1,256	$1,412	**A**	$14	$153
	EMOD	$12,796	$13,581	$14,418	$2,103	$2,495	$2,926	**A**	**A**	**A**
	Macha	$941	$976	$1,013	$274	$307	$342	$30	$55	$87
	PopART	$5,723	$5,973	$6,228	$658	$865	$1,091	**A**	**A**	**A**

'**A**' indicates the policy listed first dominates the policy listed second (i.e. lower cost, greater health benefits). '**B**' indicates the policy listed second dominates the policy listed first.

Table S9: Cost per DALY averted (2012 US$) compared to baseline strategy (CD4 ≤350 cells/μL eligibility, status quo access) in models for India

Strategy[a]	5 years			10 years			20 years		
	0% disc.	3% disc.	6% disc	0% disc.	3% disc.	6% disc	0% disc.	3% disc.	6% disc
Mishra (Belgaum)									
all HIV+, status quo	$1,195	$1,231	$1,267	$437	$466	$497	$173	$198	$228
FSW elig., status quo	$831	$857	$884	$252	$271	$291	$71	$85	$102
CD4 ≤350, exp. FSW	$2,121	$2,153	$2,186	$886	$929	$976	$348	$390	$440
FSW elig., exp. FSW	$1,468	$1,501	$1,534	$508	$539	$573	$176	$202	$232
all HIV+, exp. FSW	$1,381	$1,417	$1,455	$514	$547	$581	$206	$235	$269
CD4 ≤350, unif. exp.	$13,983	$14,155	$14,327	$7,892	$8,169	$8,458	$5,062	$5,396	$5,773
all HIV+, unif. exp.	$11,602	$11,764	$11,927	$6,012	$6,249	$6,497	$3,660	$3,927	$4,230
FSW elig., unif. exp	$13,360	$13,528	$13,697	$7,377	$7,645	$7,923	$4,605	$4,925	$5,285
Mishra, no FSW intervention									
all HIV+, status quo	$1,282	$1,316	$1,350	$512	$538	$566	$219	$241	$266
FSW elig., status quo	$655	$673	$690	$213	$225	$239	$65	$73	$83
CD4 ≤350, exp. FSW	$1,352	$1,376	$1,401	$439	$462	$488	$124	$141	$161
FSW elig., exp. FSW	$1,273	$1,298	$1,323	$368	$389	$411	$98	$112	$129
all HIV+, exp. FSW	$1,299	$1,325	$1,352	$386	$408	$431	$106	$121	$139
CD4 ≤350, unif. exp.	$7,296	$7,403	$7,511	$3,475	$3,624	$3,781	$1,631	$1,794	$1,982
all HIV+, unif. exp.	$7,065	$7,171	$7,278	$3,253	$3,397	$3,549	$1,470	$1,623	$1,800
FSW elig., unif. exp	$6,543	$6,649	$6,755	$2,834	$2,968	$3,109	$1,274	$1,409	$1,565
Pruddell (Bangalore)									
FSW elig., status quo	$1,206	$1,244	$1,283	$249	$275	$303	$11	$24	$40
MSM elig., status quo	$2,740	$2,820	$2,903	$690	$752	$821	$95	$128	$169
FSW & MSM elig, status quo	$2,179	$2,246	$2,314	$513	$562	$614	$61	$85	$116
all HIV+, status quo	$2,573	$2,650	$2,728	$649	$708	$772	$100	$131	$170
FSW elig., exp. FSW	$1,173	$1,199	$1,225	$394	$420	$447	$87	$106	$129
MSM elig., exp. MSM	$1,856	$1,894	$1,933	$895	$945	$997	$324	$377	$438
CD4 ≤350, exp. FSW & MSM	$1,700	$1,733	$1,766	$878	$920	$964	$350	$398	$455
FSW & MSM elig, exp. FSW & MSM	$1,759	$1,796	$1,834	$795	$841	$890	$264	$310	$364
IDU-Manipur (Churachandpur)									
PWID elig., status quo	$2,787	$2,848	$2,910	$657	$710	$766	$73	$107	$149
PWID & ex-PWID elig, status quo	$3,535	$3,615	$3,695	$882	$949	$1,020	$152	$197	$250
CD4 ≤350, exp. PWID	$1,572	$1,591	$1,610	$871	$911	$951	$427	$487	$553
PWID elig., exp. PWID	$1,884	$1,916	$1,948	$655	$706	$758	$98	$143	$196
CD4 ≤350, exp. PWID & ex-PWID	$1,691	$1,720	$1,748	$1,003	$1,046	$1,091	$666	$723	$785
PWID elig, exp PWID & ex-PWID	$1,848	$1,882	$1,916	$825	$877	$932	$261	$319	$386
PWID & ex-PWID elig, exp. PWID & ex-PWID	$1,981	$2,017	$2,054	$863	$920	$978	$270	$330	$401

[a] Strategy represented as < *eligibility, access* >. For example 'CD4 ≤350, exp. FSW' indicates all adults with CD4 ≤350 cells/μL are eligible and prioritised expanded access to FSW. 'unif. exp.' indicates uniformly expanded access to the general population.

Table S10: Cost per DALY averted (2012 US$) compared to baseline strategy (CD4 ≤350 cells/μL eligibility, status quo access) in model for Vietnam

Strategy[a]	5 years			10 years			20 years		
	0% disc.	3% disc.	6% disc	0% disc.	3% disc.	6% disc	0% disc.	3% disc.	6% disc
Prevtool									
FSW elig., status quo	$1,664	$1,702	$1,740	$531	$557	$585	$143	$161	$182
MSM elig., status quo	$2,060	$2,105	$2,151	$749	$783	$818	$254	$280	$311
PWID elig., status quo	$2,030	$2,076	$2,122	$743	$777	$814	$247	$274	$306
CD4 ≤500 elig, status quo	$1,241	$1,265	$1,290	$578	$598	$620	$270	$290	$313
All HIV+ elig, status quo	$2,055	$2,100	$2,146	$758	$791	$827	$263	$289	$320
FSW elig., exp. FSW	$18,779	$19,420	$20,082	$5,004	$5,362	$5,754	$1,270	$1,465	$1,705
MSM elig, exp. MSM	$11,604	$11,981	$12,369	$3,623	$3,863	$4,124	$1,187	$1,354	$1,555
PWID elig., exp. PWID	$10,529	$10,864	$11,210	$3,430	$3,652	$3,893	$1,153	$1,311	$1,502
CD4 ≤350, exp. FSW, MSM, PWID	$16,614	$17,131	$17,663	$6,190	$6,568	$6,977	$2,392	$2,692	$3,050
CD4 ≤500, exp. FSW, MSM, PWID	$12,708	$13,114	$13,533	$4,415	$4,692	$4,994	$1,631	$1,839	$2,090
All HIV+, exp. FSW, MSM, PWID	$11,664	$12,042	$12,432	$3,659	$3,901	$4,164	$1,194	$1,361	$1,563
CD4 ≤350, uniformly expanded	$87,266	$90,024	$92,861	$33,608	$35,635	$37,833	$14,277	$15,932	$17,910
CD4 ≤500, uniformly expanded	$69,338	$71,610	$73,951	$24,812	$26,372	$28,068	$10,097	$11,303	$12,750
All HIV+, uniformly expanded	$63,176	$65,296	$67,481	$20,786	$22,153	$23,644	$7,847	$8,835	$10,028

[a] Strategy represented as < *eligibility, access* >. For example 'CD4 ≤350, exp. FSW' indicates all adults with CD4 ≤350 cells/μL are eligible and prioritised expanded access to FSW. 'unif. exp.' indicates uniformly expanded access to the general population.

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